

UAS BROADCAST MEASUREMENT



May 2017

Preparing for the Broadcast Repack – Case Study

As the Over the Air Broadcast Television Industry prepares for the unprecedented impacts of the upcoming station repack, broadcasters require solutions that save time and effort in the install process. UAS Broadcast Measurement can save weeks in the time to verify the operation of the newly installed system. As recently shown in a measurement in Cedar Hill, Texas, UAS technology provides a valuable tool for verification of network operations.

UAS Broadcast Measurement

PREPARING FOR THE BROADCAST REPACK

EXECUTIVE SUMMARY

As the time remaining in the broadcast repack counts down from April of 2017 to the ending date in July of 2020, nearly one thousand broadcast television stations in the United States are working diligently to prepare for their transition from their current facilities to a newly assigned broadcast channel. The preparations for this move are not trivial and not without substantial hurdles to overcome. As much of the transition from one channel to another will require new equipment and new facilities to be installed, the element of time is the key input to the readiness equation. In nearly every forum, panel discussion, and article concerning the repack, the highest concern of broadcasters and the industry as a whole is the 39-month timeframe. The ten-phase process identified by the FCC and assigned to the broadcasters leaves little room for error and puts a premium on a station's readiness to switch at its' assigned date or face the reality of going dark until the new facilities can be brought on air. Technologies and processes that can save time can be the difference between a smooth transition and going off the air.

LS telcom's UAS Broadcast Measurement allows broadcasters to capture equipment performance at its' source and avoid the lengthy process of drive testing hundreds of square miles to validate basic operation. UAS Broadcast Measurement leverages the advanced technology of a customized Unmanned Aircraft System (UAS) to measure the output pattern of the newly installed broadcast equipment. By verifying both the horizontal and vertical pattern at the antenna, the newly installed equipment (transmitter, transmission line, and antenna system) can be rapidly validated for meeting specifications once the installation process is completed. UAS Broadcast Measurement is typically completed in a matter of one to two days. When compared to the traditional method of measuring several hundred test points on the ground that can easily take weeks to collect, the efficiency and time savings of UAS Broadcast Measurement is evident. Additionally, once measured, the collected data enables broadcasters to validate the operation of the newly installed equipment against the theoretical projections provided by the manufacturer. In addition, they can further leverage the information to identify any issues that may have occurred during the installation. Finally, the measurement data collected provides a defined baseline for equipment performance and capability that can be compared in the future to assure continued consistency in performance over time.

Time remains the biggest risk in the repack equation; requirements for services, equipment, and processes that can decrease the amount of time for a station to reach a "ready-to-switch" stage, are at a premium. The following case study outlines how UAS Broadcast Measurement can be used to improve the installation and commissioning schedule for new broadcast facilities.



CEDAR HILL TEXAS – MAY 2017

On May 6-7 2017 LS telcom completed the first UAS Broadcast Measurement in the United States. Leveraging the company's international experience of over eight hundred UAS antenna measurements, a newly installed broadband television antenna at the Cedar Hill tower farm outside of Dallas became the first broadcast antenna in the country to be validated by the UAS measurement process.

Measurements were completed for two local Dallas stations, broadcasting from a newly installed broadband antenna. The antenna was installed in anticipation of the repack to provide the baseline facility for the new frequency assignment. The signal measurements were taken for both the horizontal and vertical polarization patterns allowing for the validation of the circular and elliptical polarization being broadcast. Given the difficult logistics of the Cedar Hill facility, the use of a UAS based solution was ideal to collect the necessary broadcast data.



Over the course of two days at Cedar Hill, the location presented some unique challenges that were handled by the skilled team of experts deployed by LS telcom. As the targeted antenna was located amongst the nine towers at the Cedar Hill tower farm, a wide berth was required for the measurement completion. The height of the antenna as well as the high RF output power of the targeted measurement, combined with the outputs of other local antenna facilities, added further complexity to the level of precision and accuracy required in flight planning and mission execution.

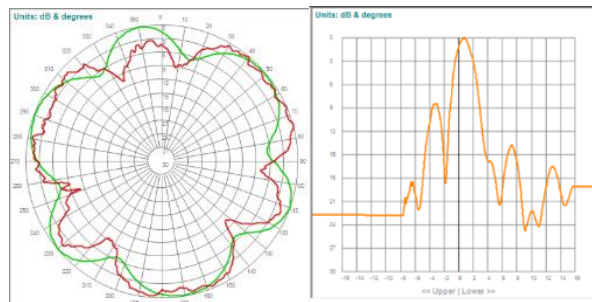


During the mission, the LS telcom team established eleven separate operational sites from which over forty individual flight segments were completed. The total circumference of flight path to cover the horizontal broadcast footprint encompassed over four miles. Once completed, the information for a 360-degree path around the tower was captured for the two target stations for both horizontal and vertical polarity of the transmitted signals. With the experience of hundreds of flight missions for the very specialized high altitude high RF power environment, LS telcom has an unmatched level of experience in these precision operations. As the flights at Cedar Hill required an altitude clearance up to approximately 1600ft AGL to properly measure the targeted antenna, the flights were completed under a Part 107 waiver granted by the FAA for the activity.

TECHNOLOGY OVERVIEW

UAS Measurements

For UAS Broadcast Measurement, LS telcom has integrated the capabilities of wideband receiver technology with a custom built UAS. The on-board payload includes the receiver and processing kit along with an antenna specifically tuned for the targeted measurements. The entire UAS system is secured and shielded to protect from the high-powered RF signals of both the measured asset as well as any other surrounding broadcast elements. The onboard processing also provides local data storage and application execution for the measurement process. While commanded from the ground station, the on-board autopilot and flight telemetry system guide the UAS through the defined mission at the proper altitudes and in the proper orientation to the targeted antenna profile. As part of the preprogrammed flight parameters, the geo-fence perimeter is also established. The defined outer barrier provides a safety net for the flight mission. Should the outer perimeter be breached, the UAS is pre-programmed to initiate landing procedures.



The measurements data captured can be used to verify the ERP of the signal from the antenna versus the expected levels of output. The data collected also identifies the down tilt of the antenna and null fills in the footprint providing further areas for validation of the installation parameters and characteristics. The UAS works in concert with ground station equipment for both the flight execution as well as the measurement data collection. In many cases of a television broadcast installation, the transmitter, transmission line, and antenna may have been purchased from three different companies. The information collected by the

measurement can be used as validation of the theoretical projections for the combined equipment set.

The measurement data collected can speed the process in the identification of potential root cause of any installation issues that may occur. Faulty splitters, bad cable connections, and incorrect down tilt angles are just a few of the easily identifiable issues from a quick review of the collected data. Each of these issues can have a significant impact in the transmission pattern of the antenna and the resulting footprint of the network. These types of issues can be difficult to diagnose with traditional testing and sometimes next to impossible to identify without physically climbing the tower.

The measurement data captured can be inserted into network planning tools for additional analysis, allowing broadcasters to compare the actual transmission patterns of the network with the theoretical projections. UAS Broadcast Measurement presents a revolutionary technology breakthrough that can help save time and increase the efficiency of the installation of new broadcast equipment.

Unmanned Aircraft System (UAS)

The UAS used for the Cedar Hill measurement is designed and built by LS telcom's subsidiary Colibrex. This UAS has been specially designed to withstand the high-powered output signals of the broadcast antennas

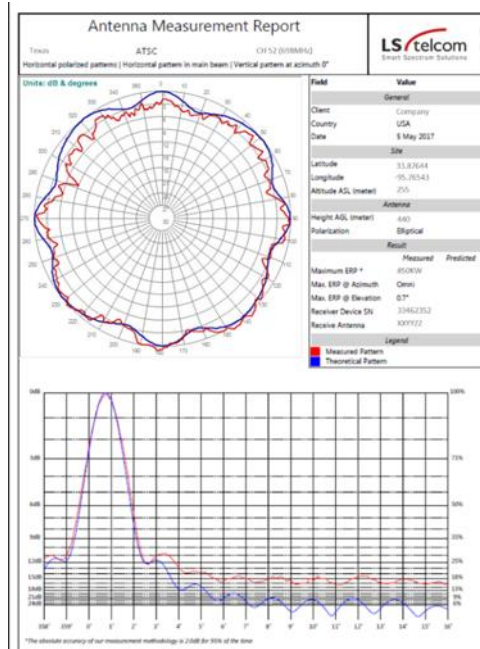


while capturing the targeted information via the customized receiver and processing payload. Additionally, the UAS is equipped with a customized autopilot and geo-fencing capability that assures the proper flight completion and information collection throughout the measurement flight.

While in flight the LS telcom UAS continually transmits data to the ground station providing information for the flight and the captured data set of the measurement. Each measurement is

captured based on calibrated way points preprogrammed into the flight plan and flown based on high-accuracy GPS. Additionally, each flight is executed under the virtual enclosure of a preset geo fence. The defined perimeter provides additional safety and protection for the flight execution.

UAS Broadcast Measurement Deliverables



Once completed the output data for each of the flights are merged together to form the 360-degree horizontal and the vertical data for the main azimuths. From this data, LS telcom produces a summary report continuing the graphical representation of each of the key measurements. The graphical report captures the key elements of the measurement at a high level and also provides a visual representation overlay with the antenna pattern provided by the manufacturer.

In addition to the summary report, the raw output data from the measurement is provided to the end customer in tabular format that is compatible for import into planning tools as an antenna pattern file information.

The combination of horizontal and vertical information can be used to verify the ground footprint, down tilt angle, azimuth, and circular or elliptical polarization of the signal. For the longer-term operations of the system, the captured data provides a baseline for the operational capability of the system that can be used in future

test and validation procedures to measure consistency of performance over time. Additionally, if changes are made to the operational configuration, future measurement data can be compared to the baseline operational data to accurately gauge the impact of the modifications on the overall operations of the network at its' source.

Alternate Technologies

One key to understanding the benefit of UAS Broadcast Measurement is to evaluate the alternatives that have been used traditionally for this type of measurement. Previous use of helicopters and airplanes to attempt to capture this type of information were overly expensive and did not provide the same level of precision measurement. Not to mention, the significant risk these methods presented. Additionally, there are many locations where using a helicopter or airplane are just not possible. However, in many of these cases the UAS technology is able to complete the mission.



Another alternative to measuring the network footprint is to use a ground based resource such as a bucket truck. This method typically takes an extensive period of time to measure hundreds of individual test points.



If used as a sole source for operational validation of the broadcast equipment, bucket truck measurement is an incomplete data set that is not well suited for rapid validation of any newly installed equipment. However, when used as a complimentary data set with a UAS Broadcast Measurement, the data collected by the bucket truck measurement method does have value for network fine tuning, as well as to address specific areas of localized coverage.

The combined data set allows broadcast engineers to make more informed decisions about the impacts of changes being made to the network.

SUMMARY

Broadcast Measurement using an Unmanned Aircraft Systems (UAS) delivers an expedient and economical way to isolate these issues and provide broadcast networks with an optimization capability that had previously been technically and economically impossible. Using the UAS as the collection vehicle, operators are able to scan the output of both the vertical and horizontal output power of their operational antennas and create the actual output pattern of the antenna. This capability allows technicians to bisect coverage issues by providing a middle checkpoint between the ground-based equipment on one end and the user device on the other.

In the compressed timeframe of just thirty-nine months to complete the nationwide process, broadcasters are searching for capabilities and technologies that increase the efficiency of the equipment installation process. LS telcom's UAS Broadcast Measurement allows broadcasters to capture equipment performance at its' source and avoid the lengthy process of drive testing hundreds of square miles to validate basic operation. The measurement data captured can be input into network planning tools for additional analysis, allowing broadcasters to compare the actual transmission patterns of the network with the theoretical projections. UAS Broadcast Measurement represents a huge savings in time, manpower, and testing effort for broadcasters, network installers, and equipment vendors throughout the country.

LS telcom is currently scheduling the UAS Broadcast Measurement service throughout the country for validation of current broadcast network operations, as well as new equipment installations. For more information please contact Info@LStelcom.us.

ABOUT **LS TELCOM**

LS telcom's software, system solutions, and services address the efficient use of radio frequency spectrum and the optimal operation of radio communication services. We are a worldwide market leader in the provision of automated spectrum management systems and their integration with monitoring systems. We also have our own monitoring system, including fixed, portable, and airborne sensors. At the same time, we develop and market software for the design, planning, and optimization of broadcast, LMR, mobile and microwave networks. Strategic consulting, radio engineering services, and training on network technologies, standards, and regulations as well as transmitter installations and measurements complete our area of expertise. Frequency regulatory authorities, ministries, network operators and infrastructure providers, system integrators and military organizations in over 90 countries across all continents rely on our solutions and services.

LS telcom operates worldwide with subsidiaries and affiliates in Canada, China, France, South Africa, UAE, UK and the United States, as well as representative offices in Argentina, Hungary, and Oman. Colibrex is a subsidiary of LS telcom. With its headquarters in Lichtenau, Baden, Germany, LS telcom is listed on the German stock exchange under ISIN DE 0005754402 since 2001. For more information please visit the LS telcom website at www.LStelcom.us.

Contact:

LS telcom, Inc.

Casey Joseph

CJoseph@LStelcom.com

(301) 377-6966

www.LStelcom.us

